Sept. 20, 1960 R. W. BOYER 2,953,098

PUMP

Filed Sept. 9, 1957 2 Sheets-Sheet 1

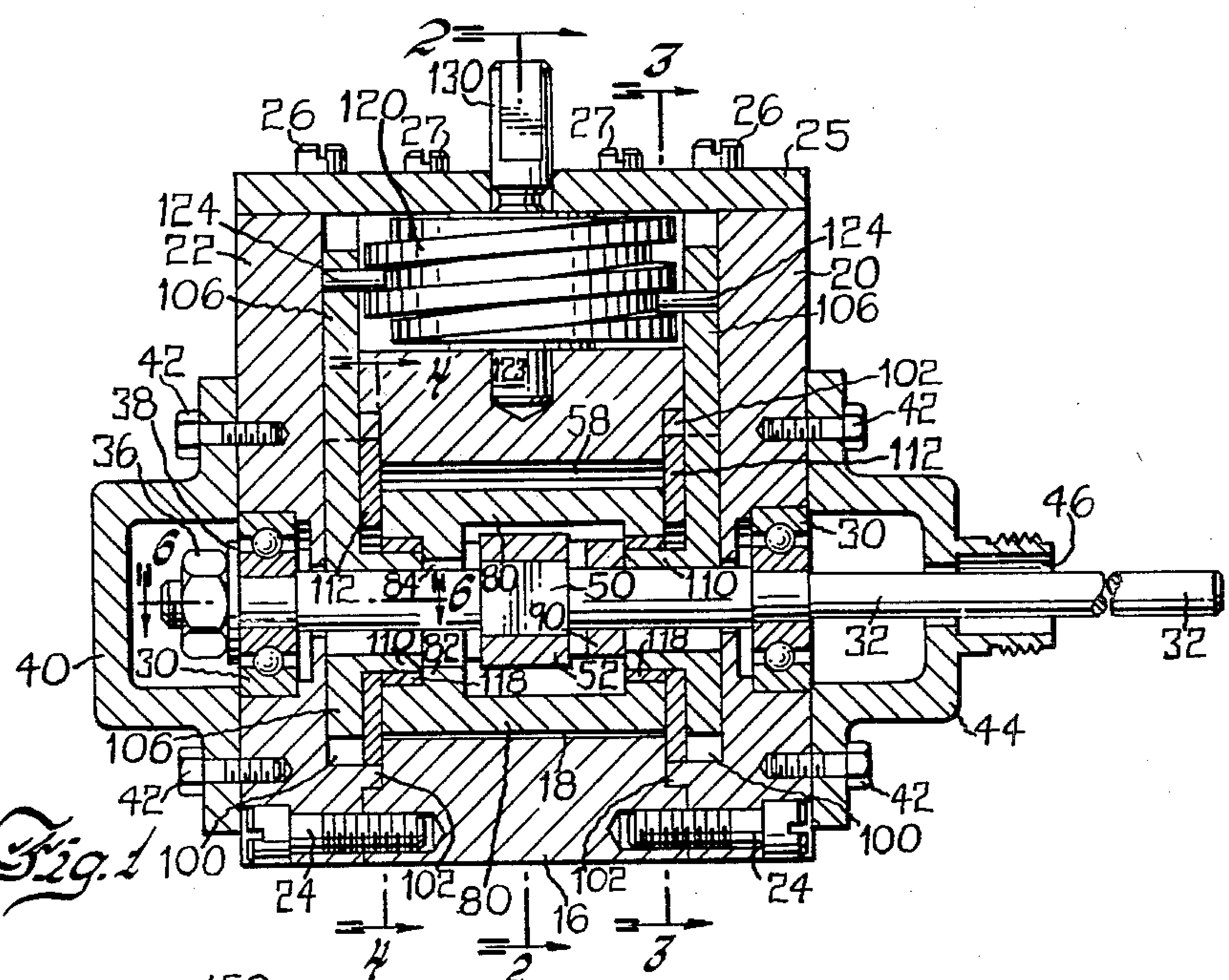

Fig. 1

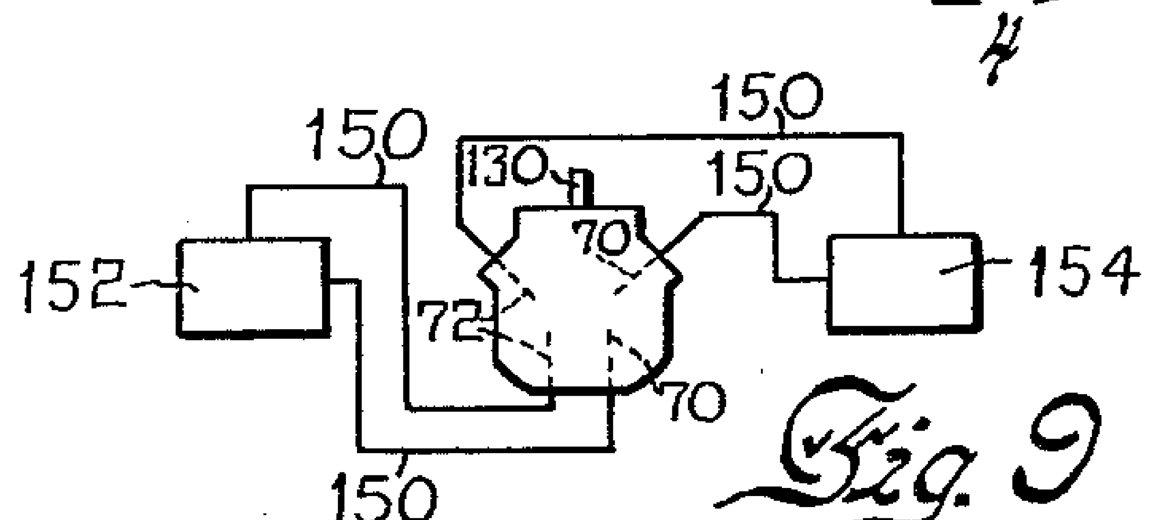

Fig. 9

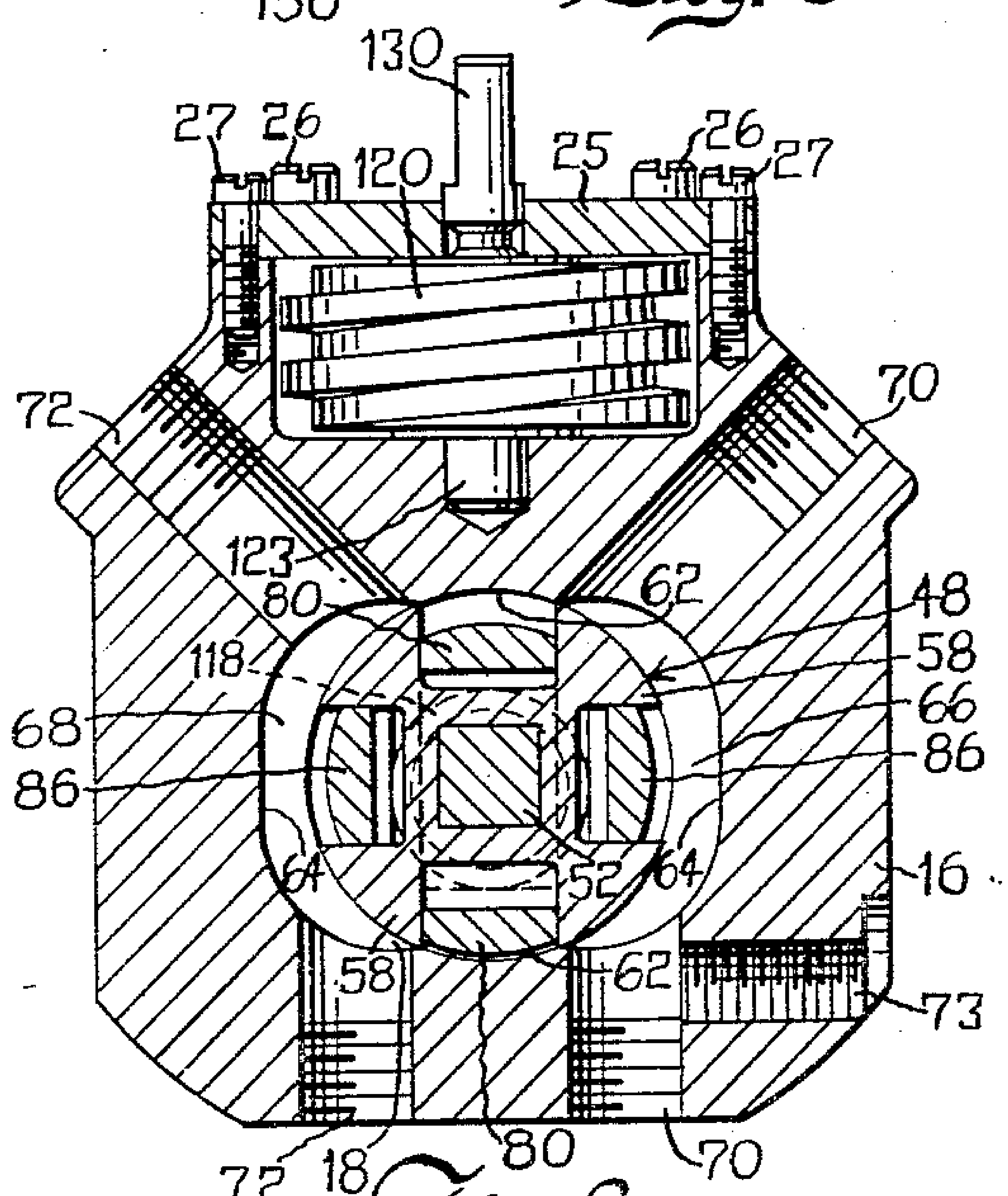

Fig. 2

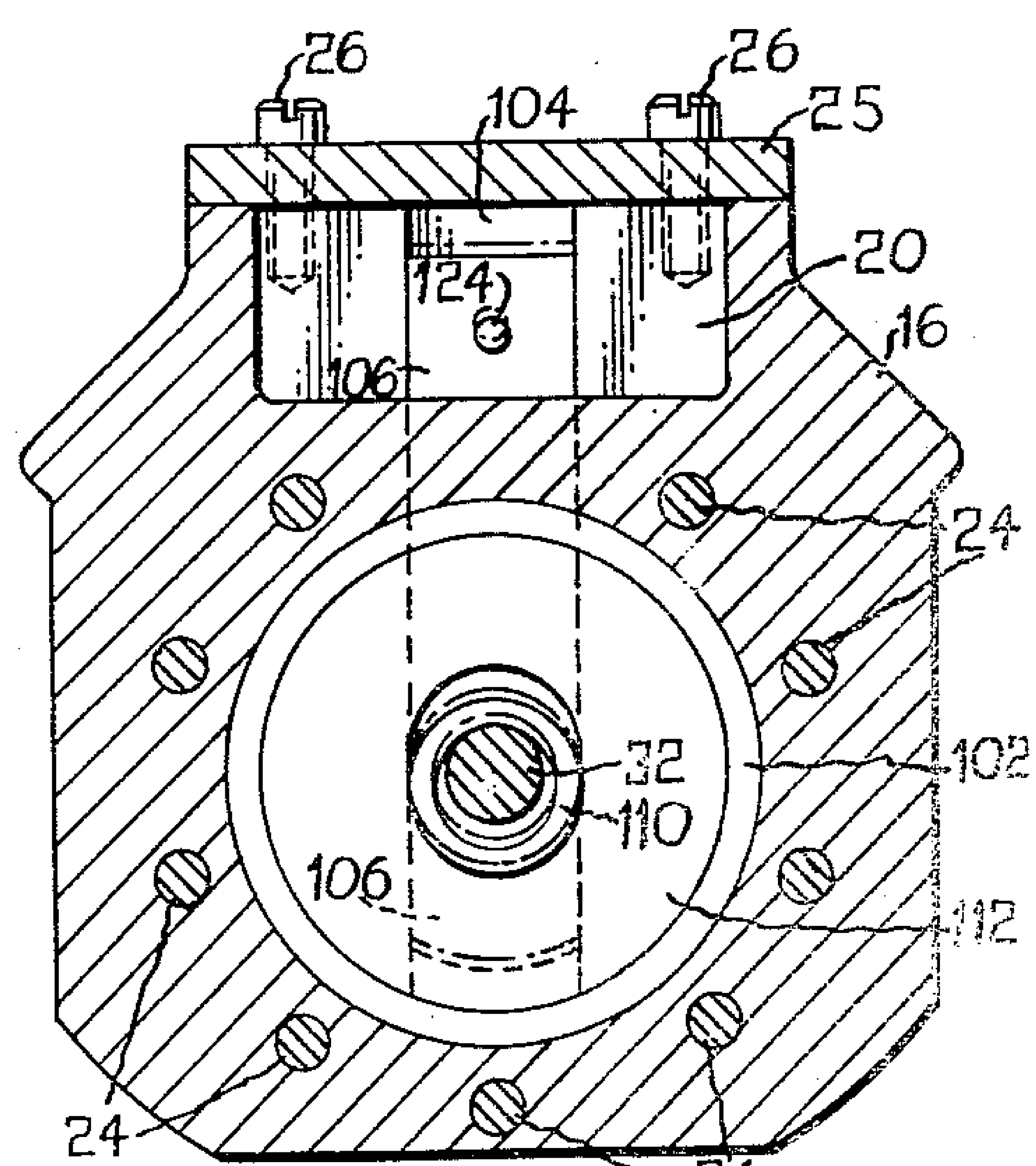

Fig. 3

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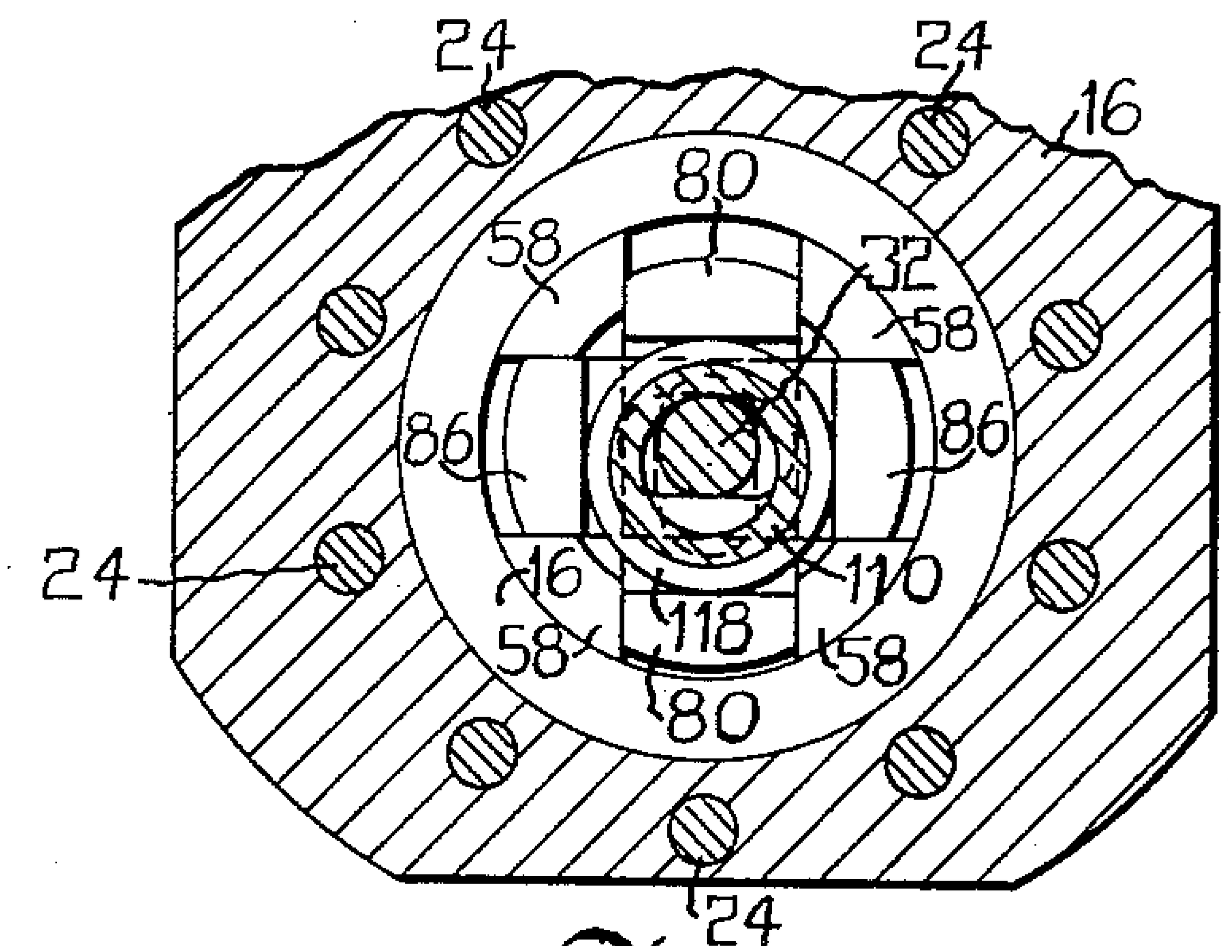

Fig. 4

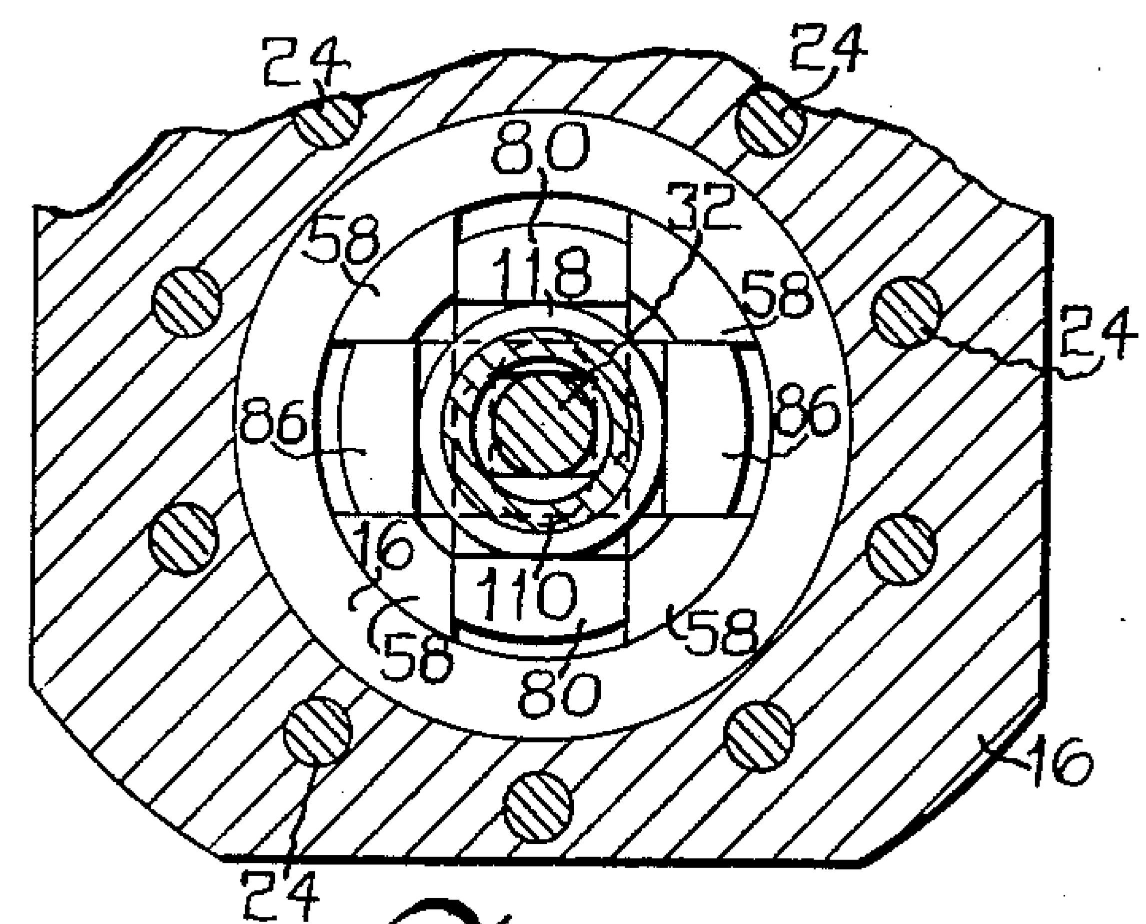

Fig. 5

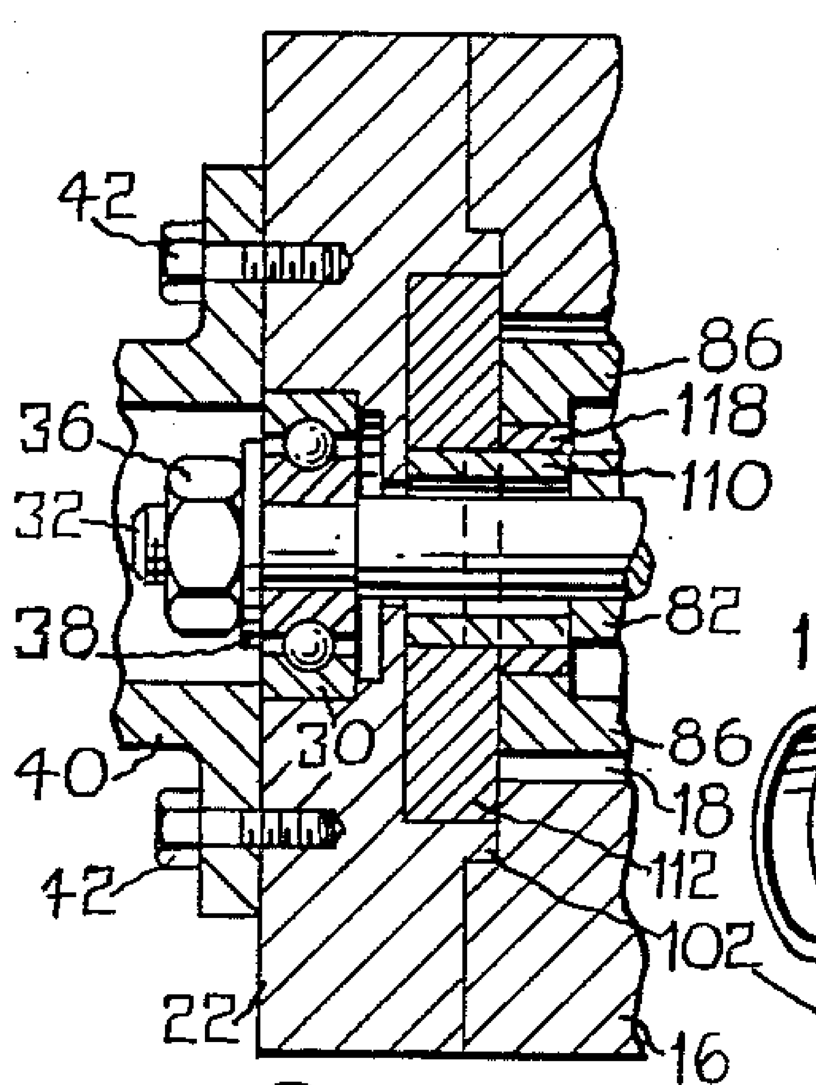

Fig. 6

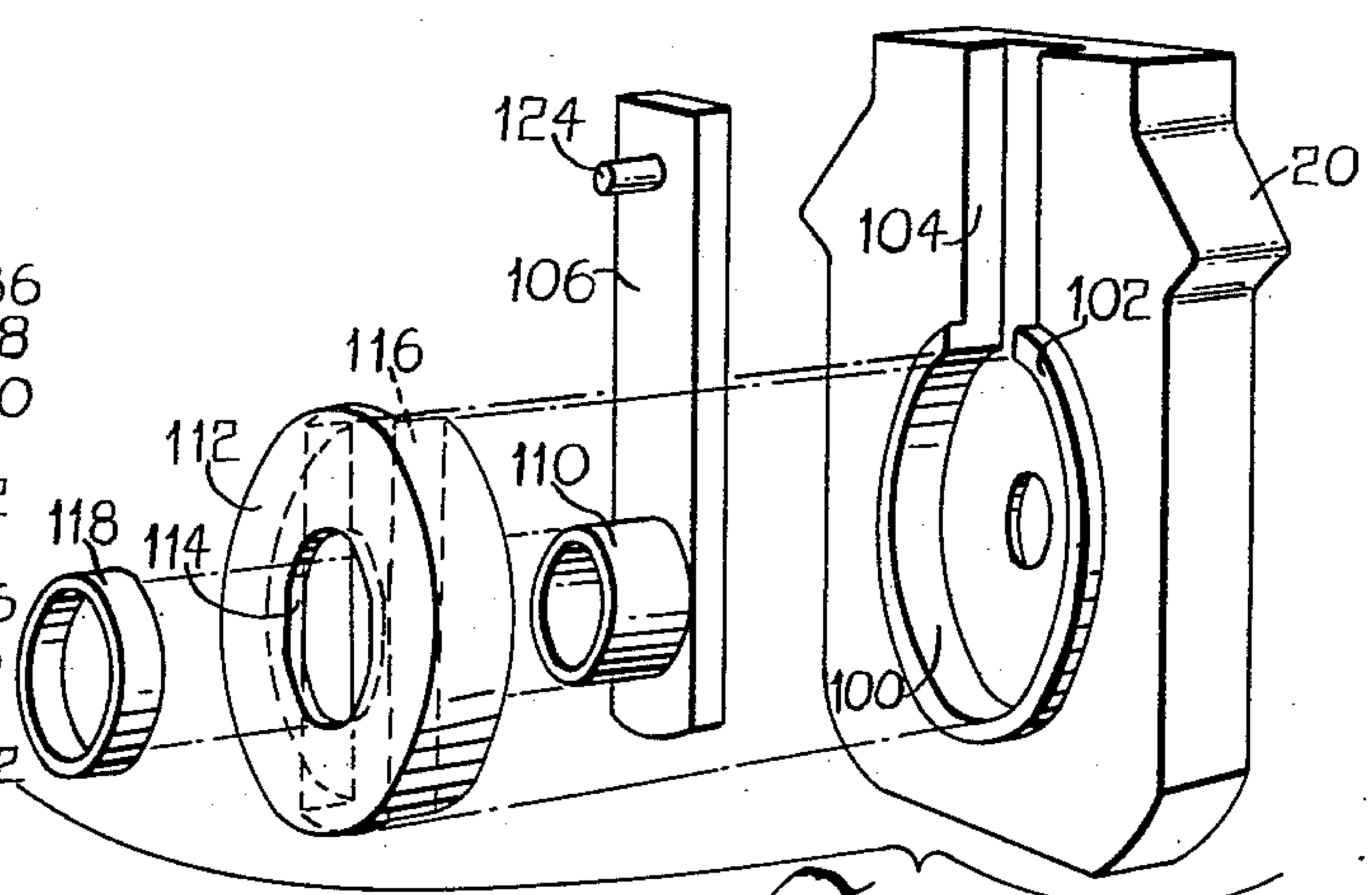

Fig. 7

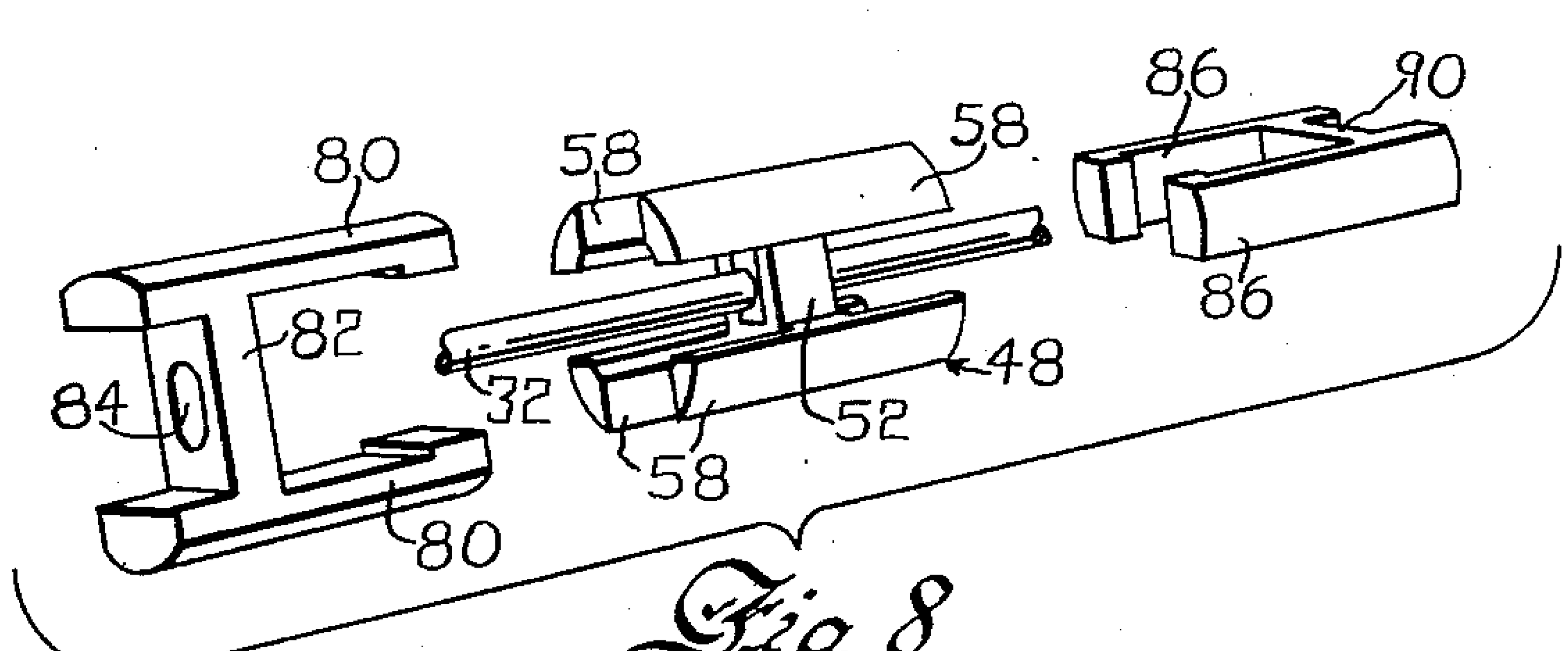

Fig. 8

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1 Claim. (Cl. 103—161)

This invention relates to a pump. This invention relates more particularly to a reversible delivery adjustable displacement pump. The invention also relates to a pump of the type disclosed by the Grey Patent 2,273,034 and is an improvement upon the structure of said patent. However, this application is not so limited due to the fact that this invention may be applied to other mechanisms.

The aforesaid patent discloses a reversible delivery rotary pump which is provided with means for adjusting the rate of delivery of the pump. It is highly desirable to provide means by which the rate of delivery of the pump may be easily and readily adjusted as the rate of rotation is held constant. It is also highly desirable that such adjustment be firmly mantained so that the adjusted rate of delivery does not change if a given rate of rotation of the pump is maintained.

It is an object of this invention to provide a reversible delivery adjustable displacement pump having means by which the displacement is easily and readily adjusted during operation of the pump.

Another object of this invention is to provide such a pump apparatus, the rate of delivery of which is firmly maintained at any adjusted position.

Other objects and advantages reside in the construction of parts, the combination thereof, the method of manufacture, and the mode of operation, as will become more apparent from the following description.

In the drawings:

Figure 1 is a longitudinal sectional view of a pump of this invention.

Figure 2 is a sectional view taken substantially on line 2—2 of Figure 1.

Figure 3 is a sectional view taken substantially on line 3—3 of Figure 1.

Figure 4 is a fragmentary sectional view taken substantially on line 4—4 of Figure 1.

Figure 5 is a fragmentary sectional view similar to that of Figure 4. Figure 5 shows the adjustable piston members in a different position thereof from that shown in Figure 4.

Figure 6 is a sectional view taken substantially on line 6—6 of Figure 1.

Figure 7 is a perspective exploded view showing elements of the pump of this invention.

Figure 8 is a perspective exploded view showing other elements of the pump of this invention.

Figure 9 is a diagrammatic view showing the pump of this invention connected to a plurality of fluid motors for the operation thereof.

Referring to the drawings in detail, a pump of this invention includes a housing 16 provided with a longitudinal bore or cavity 18 extending therethrough. The housing 16 is provided with an end plate 20 at one end thereof and an end plate 22 at the other end thereof. The end plates 20 and 22 are attached to the housing 16 by any suitable means such as by means of a plurality of bolts or screws 24.

The end plates 20 and 22 extend upwardly at the ends of the housing 16 and are joined together at the upper ends thereof by means of a plate 25. Cap screws 26 extend through the plate 25 and into the end plates 20 and 22 for attachment therebetween. Cap screws 27 extend through the plate 25 into the housing 16 for attachment therebetween.

Each of the end plates 20 and 22 carries an antifriction bearing 30. The antifriction bearings 30 rotatably support a shaft 32. The shaft 32 extends slightly from the end plate 22 and is provided with a nut 36 and a washer 38 which retain the shaft 32 against axial movement. A cover plate 40 encloses the end of the shaft 32 and is attached to the end plate 22 by means of bolts 42.

A cover plate 44 is attached to the end plate 20 and is provided with an opening 46 through which the shaft 32 extends to any desired length for connection to a suitable driving means.

The shaft 32 carries a rotor 48. The shaft 32 has a square section 50 intermediate the bearings 30 to which is firmly attached a hub 52 of the rotor 48, as shown in Figure 1. The rotor 48 also includes wing members 58 which are attached to the hub 52 and extend outwardly therefrom at opposite portions thereof. The outer surface of each of the wing members 58 is arcuate, the arcuate surfaces of all of the wing members 58 having a common center at the center of the shaft 32. The wings 58 with the hub 52 attached to the shaft 32 rotate within the bore 18 of the housing 16. The bore 18 has arcuate surfaces 62 at oppositely disposed portions thereof. The center of the arc forming the arcuate surfaces 62 is at the center of the shaft 32 and the radius of the arcuate surfaces 62 is slightly greater than the radius from the center of the shaft 32 to the arcuate surfaces of the wings 58. Thus, as the rotor 48 revolves within the bore 18 there is very small distance between the arcuate surfaces of the wings 58 and the arcuate surfaces 62 of the cavity 18.

The bore 18 has oppositely disposed wall surfaces 64 which are spaced considerably farther from the center of the shaft 32 than the arcuate surfaces 62. The surfaces 64, as shown in Figure 2, are disposed somewhat normal to the arcuate surfaces 62 so that chambers 66 and 68 are formed at opposite portions of the rotor 48. The chamber 66 connects to a pair of fluid conduits 70. The chamber 68 connects to a pair of fluid conduits 72. The conduits 70 and 72 extend to the exterior of the housing 16, as shown in Figure 2. Also, as shown in Figure 2, the housing may be provided with a conduit 73 joining the lower conduit 70. The conduit 73 may be used as a filler passage, if desired.

The rotor 48 carries a pair of pistons 80 which are attached one to the other by a link 82, as shown in Figure 8. The link 82 is provided with an elongate aperture 84 therein through which the shaft 32 extends, permitting the pistons 80 to be disposed at opposite sides of the shaft 32 and intermediate opposite wings 58 of the rotor 48. The rotor 48 also carries a pair of pistons 86, similar to the pistons 80. The pistons 86 are connected one to the other by means of a link 90. The link 90 has an elongate aperture therein, similar to the aperture 84, through which the shaft 32 extends. The pistons 86 are thus positioned in other slots of the rotor 48 and are substantially normal to the pistons 80, as shown in Figure 8.

Thus, the pistons 80 and 86 are carried by the rotor 48, each piston 80 or 86 being disposed between two of the wings 58 and slidably engageable therewith. Each piston 80 and 86 is thus reciprocally movable normal to the shaft 32.

Each of the end plates 20 and 22 is provided with a substantially circular recess **100** therein. In the exploded view of Figure 7 the end plate **20** is shown. The end plate **22** is similar thereto. Extending around most of the recess **100** is a flange **102** which extends outwardly from the end plate **20**.

Joining the recess **100** and extending radially therefrom is a channel **104**. The channel **104** serves as a guide for a connector bar **106** which is slidably disposed therein. The connector bar **106** extends into the recess **100** and has a support cylinder **110** attached thereto and extending normally therefrom. The shaft **32** extends through each connector bar **106** and its respective support cylinder **110** which are disposed at each end of the rotor **48**.

A guide plate **112** is disposed within the recess **100** of each of the end plates **20** and **22**. Each guide plate **112** has an elongate aperture **114** through which the shaft **32** extends. Each guide plate **112** is provided with an elongate slot **116** within which its respective connector bar **106** slidably moves. Each support cylinder **110** extends through the aperture **114** of its respective guide plate **112**.

A bearing member **118** is carried by each support cylinder **110**. The bearing members **118** are thus disposed at opposite ends of the rotor **48**. The bearing members **118** are of such diameter that all of the pistons **80** and **86** slidably engage the bearings **118** for rotation thereupon.

The inside diameter of each support cylinder **110** is considerably larger than the diameter of the shaft **32**. The support cylinders **110** are movable with respect to the shaft **32**. The support cylinders **110** are movable within the elongate apertures **114** of the guide plates **112**.

Rotatably supported at the upper portion of the housing **16** and intermediate the end plates **20** and **22**, as shown in Figures 1 and 2, is an adjustment screw **120** which is shown as being provided with square threads. The screw **120** has an end **123** rotatably retained in the housing **16**. The screw **120** has an extension **130** at the opposite end thereof. The extension **130** is journalled in the plate **25**. The extension **130** is adapted for engagement with any suitable means for rotation thereby.

Each of the connector bars **106** is provided at the upper portion thereof with a pin **124** rigidly attached thereto and extending into the threaded portion of the adjustment screw **120**, as shown in Figure 1.

Operation

The shaft **32**, extending from the cover plate **44** is attached to any suitable means for rotation thereof. Rotation of the shaft **32** causes rotation of the rotor **48**. The rotor **48** carries therewith the pistons **80** and **86**. The pistons **80** and **86** are journalled upon the bearing members **118**.

Due to the fact that the support cylinders **110** are reciprocally movable along a line normal to the axis of the shaft **32** by the connector bars **106**, the support cylinders **110** and the bearings **118** may be moved to positions eccentric with respect to the shaft **32**. The eccentricity of the bearings **118** with respect to the shaft **32** is adjusted by means of the adjustment screw **120** which is rotated by any suitable means in engagement with the extension **130**. As the adjustment screw **120** is rotated the threads thereof cause movement of the pin members **124**, adjusting the pin members toward or away from the shaft **32**. Movement of the pin members **124** causes movement of the connector bars **106**. Thus, with rotation of the adjustment screw **120** the connector bars **106** move reciprocally and along a line normal to the shaft **32**. Thus, the eccentricity of the bearings **118** with respect to the shaft **32** is adjusted. The eccentricity of the bearings **118** with respect to the shaft **32** is either upwardly or downwardly with respect to the shaft **32** as the support cylinders **110** move upwardly or downwardly within the elongate apertures **114** of the guide plates **112**.

As shown in Figure 2, as a result of the eccentricity of the bearings **118** with respect to the shaft **32** the lower piston **80** may be disposed in close relationship to the lower arcuate surface **62** while the upper piston **80** is farther spaced from the upper arcuate surface **62**.

When the pistons **80** or **86** are positioned horizontally, as shown in Figure 2, such pistons are at equal distances from the shaft **32**. However, as the rotor **48** rotates one piston of each pair of the pistons **80** and **86** reciprocally moves closer to the shaft **32** while the other piston of the pair moves away from the shaft **32**, the pistons being carried by the eccentrically disposed bearings **118**. Thus, as the rotor **48** revolves, any given one of the pistons **80** or **86** moves farther into the chamber **66** while its opposite piston **80** or **86** moves farther from the chamber **68**.

In the description of the pumping operation of the apparatus of this invention, for purposes of illustration it will be assumed that fluid enters the chamber **66** through both of the fluid conduits **70**, as shown in Figure 2. It will also be assumed that the rotor **48**, as shown in Figure 2, is rotating counterclockwise. Thus, as the piston **80**, shown in the lowest position, moves within the chamber **66**, fluid within the chamber **66** enters the space intermediate the wings **58** within the chamber **66**, engaging the outer surface of the piston disposed therebetween. As the rotor **48** continues to revolve the piston is moved to the uppermost position as shown in Figure 2. In this position the piston is closest to the shaft **32**. In this position the uppermost piston has a considerable quantity of fluid between the upper surface thereof and the surface **62** of the bore **18**. As the rotor **48** continues to revolve, the piston and the wings **58** in contact therewith move into the chamber **68**. During this rotary movement of the rotor **48**, a piston in the uppermost position moves to the left-hand position, as shown in Figure 2. During this movement of the piston from the uppermost position to the left-hand position, fluid gathered from the chamber **66** is forced into the chamber **68**. Fluid is thus forced to flow outwardly from the chamber **68** through the conduits **72**.

Thus, it is understood that as the rotor **48** revolves, the pistons **80** and **86** reciprocally move about the eccentrically located bearings **118**. Each of the pistons **80** and **86**, slidingly moving between pairs of wings **58**, gathers fluid from the chamber **66** and discharges fluid into the chamber **68**.

It is to be understood that the direction of the pumping action depends upon the direction of rotation of the rotor **48**. The direction of pumping action also depends upon the direction of eccentricity of the bearings **118** with respect to the shaft **32**. If the eccentricity of the bearings **118** is below the shaft **32**, the direction of pumping action is such that fluid flows into the chamber **66** and out of the chamber **68** when the rotor **48** is revolving counterclockwise. With the same direction of rotation of the rotor **48**, the direction of fluid flow is reversed by changing the eccentricity of the bearings **118** to a position above the shaft **32**.

It is further to be understood that the rate of flow or delivery of the pump of this invention depends upon the degree or amount of eccentricity of the bearings **118** with respect to the shaft **32**. For example, in Figure 4 a large amount of eccentricity of the bearings **118** is shown compared to the eccentricity of the bearings **118** in Figure 5. Thus, the rate of delivery of the pump with the eccentricity shown in Figure 4 is considerably greater than the rate of delivery of the pump with the eccentricity as shown in Figure 5 for the same rate of speed of the shaft **32**.

The adjustment screw **120**, shown in Figures 1 and 2, is easily and readily adjusted by any suitable means. The screw **120** may be adjusted while the pump is operating. Thus, the direction and/or rate of delivery is easily adjusted during pumping operation. The adjusted position of the screw **120** is firmly retained in any position thereof due to the fact that the adjustment screw **120** cannot be rotatively moved without engagement with the extension **130**.

As shown in Figure 9, the pairs of conduits **70** and **72** of the housing **16** may communicate with conduits **150** which extend from the housing **16** to fluid motors **152** and **154**. Thus, a plurality of fluid motors may be operated simultaneously by a pump of this invention.

Due to the fact that the rate and direction of pumping action may be readily controlled by adjustment of the screw **120**, the direction and rate of operation of all the fluid motors connected to a pump of this invention may be controlled by adjustment of the screw **120**.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claim.

Having thus described my invention, I claim:

A variable displacement fluid pump comprising a housing having a bore therethrough, a pair of end plates, there being an end plate at each end of the housing, a shaft extending through the bore of the housing and rotatably carried by the end plates, a rotor carried by the shaft within the bore, each of the end plates having a recess therein facing the rotor, each end plate also having a channel therein facing the rotor and extending from the recess, a plurality of guide plates, there being a guide plate disposed within the recess of each end plate, each guide plate having a slot therein in alignment with the

channel, a plurality of connector bars, there being a connector bar slidably movable within the slot of each guide plate and within the channel of each end plate, each guide plate having an elongate aperture therein through which the shaft extends, a plurality of support cylinders, there being a support cylinder attached to each connector bar and encircling the shaft, each support cylinder having an inside diameter considerably larger than the diameter of the shaft extending therethrough, each support cylinder also extending through the elongate aperture of the guide plate and movable therewithin, each cylinder also being movable normal to the shaft, a plurality of bearings, there being a bearing carried by each support cylinder, a plurality of pairs of pistons slidably supported by the rotor and rotatably carried by the bearings, an adjustment screw carried by the housing and rotatable about an axis substantially normal to the shaft, a plurality of pins, there being a pin firmly attached to each connector bar and disposed in engagement with threads of the screw so that rotation of the screw causes movement of the connector bar along a line normal to the shaft and thus causes movement of the bearings along lines normal to the shaft, thus changing the eccentricity of the bearings with respect to the shaft.

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